Cambushinnie 400 kV Substation: Haul Track

Geo-Environmental Desk Study

June 2025

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Quality information

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Revision History

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Issue 0	26/03/2025	Draft 1	GB	George Baggott	Associate Director – Geo-environmental
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The opinions expressed in this Report and the comments and recommendations given are based on a desk assessment of readily available information and an initial site reconnaissance by an AECOM Engineer. At this stage intrusive investigations have yet to be undertaken at site to establish actual ground and groundwater conditions and to provide data for an assessment of the geo-environmental status of the site.

Unless otherwise stated in this Report, the assessments made assume that the sites and facilities will continue to be used for their current purpose without significant changes.

Reference to historical Ordnance Survey (OS) maps and/or data provides invaluable information regarding the land use history of a site. However, it should be noted that historical evidence will be incomplete for the period pre-dating the first edition and between the release of successive maps and/or data.

Certain statements made in this Report that are not historical facts may constitute estimates, projections or other forward-looking statements and even though they are based on reasonable assumptions as of the date of this Report, such forward-looking statements by their nature involve risks and uncertainties that could cause actual results to differ materially from the results predicted. AECOM specifically does not guarantee or warrant any estimate or projections contained in this Report.

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1. Introduction

1.1 Commission

Scottish Hydro Electric Transmission known as Scottish & Southern Electricity Networks ('SSEN Transmission') (the Client), has instructed AECOM UK Limited (AECOM) to carry out a Geo-Environmental Desk Study of the site area of the Cambushinnie Haul Track, shown in **Figure 2-1, Appendix A Figures** of the Cambushinnie 400 kV Substation Haul Track EA, hereafter referred to as the 'Site'.

The Geo-Environmental Desk Study is required to characterise potential land quality constraints / opportunities, and to provide input as baseline data to the Environmental Assessment.

1.2 Background and Proposed Development

The Site is proposed to be redeveloped to construct and operate the Cambushinnie haul track. The Cambushinnie haul track, is hereafter referred to as the 'Proposed Development'.

The Proposed Development is anticipated to require the following stages:

- Site earthworks, including excavation levelling, modifications to existing flood defences and landscaping for external areas;
- Installation of services, site drainage and flood relief culverts; and
- Construction of the new haul track, bridge, site compounds and fencing.

The Proposed Development will include the following components, as shown in **Figure 2-2 and Figure 2-3, Appendix A Figures** of the Cambushinnie 400 kV Substation Haul Track EA:

- The haul track would be approximately 1.2 km in length and 6.5 m wide between the A822 and the existing access track to the Braco West Substation and would cross the B8033 south of Braco. It would include a bell mouth junction at the A822, and for approximately 521 m (to approximately NN 83111 09166), it would comprise of tarmacadam surfacing. From approximately NN 83252 09130 to approximately NN 83090 09180 (the wheel wash) there will be 155 m of tarmacadam. At the end of the operational phase of the Proposed Development, this would be stripped back and returned to Type 1 for the landowner. The remaining area of the haul track, west of this wheel wash, to the point where the haul track meets the existing access track, would comprise of approximately 684 m of unbound type 1 material;
- Between the A822 and the B8033, the haul track would be on an embankment above the existing ground level, increasing in height in proximity to the bridge over Keir Burn. Where the haul rack route passes through the coniferous tree plantation in the west of the Site, a section of the haul track would be in a cutting, which would require excavation;
- A temporary bridge is proposed, spanning the Kier Burn, which would be 4.1 m in height from the existing ground level to the parapet and 48 m in length. The bridge will be clear span with permanent bridge abutments to support the bridge either side of the burn;
- Two temporary compounds would be required during the construction phase of the Proposed Development. One would be located adjacent to the A822 directly to the south of the haul track and would be required to enable construction works. This would be decommissioned at the end of the construction phase. The other would be located west of the B8033 directly to the south of the haul track and would be an access control compound. The access control compound would include car / van parking spaces, a welfare unit for security, heavy goods vehicle (HGV) holding area and room for transport turning. The temporary compounds may be lit during construction working hours during winter periods. This would be decommissioned at the end of the construction and operation phase of the Proposed Development.;
- Other permanent works include:
  - Bridge abutments;
  - Riverbank reinforcement; and
  - Flood relief culverts;

- Other temporary works include:
- Areas of Bridge Fabrication;
- Crane Pad Areas;
- Topsoil Storage Areas;
- Vehicle Cleaning Point;
- Vehicle Management;
- Acoustic Barriers;
- Temporary Culverts; and
- Fencing.

1.3 Planning Status

The Perth and Kinross Council web-based planning portal was reviewed to identify whether there are existing planning conditions which relate to the site area. The only application listed within the online planning portal was for the works outlined in this report (The Proposal Application Notice (PAN). The application, (24/00012/PAN) was submitted on the 25 October 2024 and a decision was made on the 04 November 2024. The planning portal does not outline the results of the decision or any planning conditions which relate to the site.

1.4 Aims and Objectives

The objective of this Geo-Environmental Desk Study is to characterise the environmental setting and sensitivity across the Site, along with the potential for contamination sources to exist and the pathways through which contamination may come into contact with sensitive receptors given the Proposed Development as a new haul track. The Geo-Environmnetal Desk Study includes the following key activities:

- Review of aerial imagery for the Site layout and terrain evaluation to provide a current description of the Site's layout and setting within the local area;
- Review of historical land uses for the Site and surrounds with a particular emphasis on identifying potential on-site and off-site contamination sources, and potential for Made Ground;
- A review of the Site's geological (including available British Geological Survey (BGS) borehole records), hydrological and hydrogeological setting, publicly available non-coal and coal mining records and geo-environmental information to build up an understanding of the Site setting and surrounding environmental sensitivity;
- Request and review relevant records held by the Local Authority Contaminated Land Officer and The Scottish Environment Protection Agency (SEPA) along with public regulatory records provided within Groundsure Reports purchased for the Site;
- Review publicly available records from consultees including (but not limited to) Historic Environment Scotland website, the Zetica bomb risk maps, UK Radon website, flooding information, the National Library of Scotland etc. to further inform the study;
- Develop a preliminary Conceptual Site Model (CSM) for the Site to identify the potential contamination sources, pathways, and receptors for consideration in the context of the potential development followed by a preliminary qualitative risk assessment for the Site;
- Summarise identified geo-environmental and land quality risks; and
- Recommendations for further geo-environmental assessments, if considered to be required.

1.5 Sources of Information

This report has been prepared using a combination of published records (e.g. British Geological Survey (BGS), SEPA) and other sources such as the Local Authority Contaminated Land Officer. These include; statutory records and historical mapping supplied within a Groundsure Report, published geological and hydrogeological mapping, historical borehole records and observations made during the site reconnaissance.

The following bodies were consulted during the assessment:

- Groundsure Enviro+Geo Insight[1];
- The Coal Authority (CA)[2];
- British Geological Survey (BGS)[3];
- Scottish Environment Protection Agency (SEPA)[4];
- SEPA Flood Risk[5];
- Historic Environment Scotland (HES) PASTMAP[6];
- Zetica UXO Map[7];
- UK Radon Map[8];
- Topography map[9]; and
- Google Earth satellite imagery[10].

Specific information sources are referenced throughout the document.

1.6 AECOM Report Approach

Detailed information relating to AECOM's approach to this report is included within **Appendix A Approach to Reporting**. This should be read in conjunction with the report, and contains information on the general approach to reporting, specific limitations of relevant sections and information on the approach to risk assessment utilised.

[1] Groundsure, 2024. *Enviro+Geo Insight* (ref. GSIP-2024-14502-17022), Dated 01 January 2024
[2] The Coal Authority, n.d. *Mining Remediation Authority Map Viewer.* [online] Available at: https://datamine-cauk.hub.arcgis.com/ (Accessed February 2025)
[3] British Geological Survey, 2020. *GeoIndex Onshore.* [online] Available at: https://mapapps2.bgs.ac.uk/geoindex/home.html?_ga=2.69978576.1741440196.1702550547-666722996.1702550547 (Accessed February 2025)
[4] SEPA, 2021. *Water Environment Hub* [online] Available at: https://informatics.sepa.org.uk/RBMP3/ (Accessed February 2025)
[5] SEPA, 2025. *Floodmaps*. [online] Available at: https://map.sepa.org.uk/floodmaps/FloodRisk/Search (Accessed February 2025)
[6] Historic Environmnet Scotland, 2025. *PASTMAP.* [online] Available at: https://pastmap.org.uk/ (Accessed March 2025)
[7] Zetica UXO, 2025. *Risk Maps.* [online] Available at: https://zeticauxo.com/guidance/risk-maps/ (Accessed February 2025)
[8] UKradon, 2022. *UK Radon Map*. [online] Available at: https://www.ukradon.org/information/ukmaps (Accessed February 2025)
[9] Topographic-map.com, n.d. *UK Topographic Map*. [online] Available at: https://en-gb.topographic-map.com/map-cgt/United-Kingdom/ (Accessed February 2025)
[10] Google Earth, 2025. Google Earth Satelltite Imagery. [online] Available at: https://earth.google.com/static/multi-threaded/versions/10.77.0.1/index.html?#@-3.47981663,150.00030013,-3256.63719952a,18709751.81607485d,35y,165.58670573h,0t,0r (Accessed February 2025)

2. Site Information

2.1 Site Details

The Site description and location details are summarised in **Table 2-1** below:

Table 2-1 Site Details

Item	Summary
Grid Reference	282889, 709236
Size	Approximately 19.08 ha
Address	The nearest address to the Site is 16 Commander's Grove, Braco, Dunblane FK15 9QZ (approximately 50 m north from the Site).
Site Location	The Site is located within the lowlands area of Scotland, to the south of the village of Braco and north of the village of Greenloaning. The national grid reference of the centre of the Site is NN828092 and nearest postcode is FK15 9QZ. The Site is a series of agricultural fields, which are predominately flat with a minor fall to the east. The Site's eastern boundary is the A822 and southern boundary is B8033.
Current Use	The Site is predominately grazing fields with some areas of low-lying vegetation and agricultural arable fields.
Surrounding Land Uses	Surrounding land uses include: • **North** – The primary surrounding land use is grazing fields. Some areas of agricultural arable fields and low-lying vegetation (surrounding the nearby waterways and ponds) are noted in the area. The village of Braco is located at approximately 50 m north of the Site. • **East** – The primary surrounding land use is grazing fields. Some areas of agricultural arable fields and low-lying vegetation (surrounding the nearby waterways and ponds) with pockets of forestry in between are identified in the area. The Braco New Cemetery is located at approximately 125 m east of the Site. • **South** – The primary surrounding land use is a mix of grazing fields and forestry. Some fields of agricultural arable land are noted in the area as well. The nearest land users are unnamed farmhouses and the Cur Coats Boutique, located approximately 60 m south of the Site. The nearest village to the south is Greenloaning, located approximately 1.1 km from the Site. • **West** - The primary surrounding land use is a mix of grazing fields and agricultural arable fields. The nearest land users are unnamed farmhouses and the Gamekeeper Cottage, located approximately 50 m southwest of the Site.

2.2 Site Reconnaissance

An inspection of the Site was completed by two suitably qualified and experienced AECOM Engineers on 15 January (in the area of Allan Water), 26 March 2024 (in the area of Haul Track), 11 June 2024 (in the area of Haul Track). The aim of the visit was to identify the range of activities carried out on the Site and any obvious potential sources of ground contamination or geotechnical issues. A photographic record of the visit is included as **Appendix B Photographic Log**.

Table 2-2 Walkover Information Summary

Item	Summary
Site Description	The Site is mainly farmland, grazed fields with no stock present at time of visit and woodland areas. The land use towards the western end of the Proposed Development is predominantly woodland and shrubbery. Moving east, the Site enters an agricultural field. There are several small drainage ditches with long grasses, shrubbery and other vegetation growing on the banks. The haul track alignment then crosses the B8033 and enters another set of agricultural fields. The B8033 is separated from the field by a barbed wire fence and hedge. The fields towards the eastern end of the haul track alignment are separated by Keir Burn. Keir Burn has manmade flood alleviation embankments either side. The burn has shrubbery and trees on the bank edges.
Topography	The Site is generally flat with a slight decline in topography towards Keir Burn.
Potential observed contamination issues	Made Ground potentially associated with the construction of power poles within the east of the site, and roads within the Site (A822, B8033). No other potential sources of contamination were observed.
Invasive Plant Species	None observed – though the survey was not carried out by a trained ecologist, and an invasive species survey is not included in the scope of this study. The Ecology reporting for the

Item	Summary
	Proposed Development should be referred to for any relevant information on Invasive Plant Species (INNS).
Drainage	The farm fields to the west of the Proposed Development crosses some drainage ditches four times. These drainage ditches flow roughly north to south and eventually into Allan Water.

3. Historical Land Use

3.1 Introduction

Historical Ordnance Survey (OS) maps of the Site and the wider environs were provided in the Groundsure Map Insight Report (scale 1:10,560) and from publicly accessible aerial photography. These are reviewed in this section. Copies of these maps are presented as part of the Groundsure Map Insight Report in **Appendix C Groundsure Report**.

The historical OS maps obtained with the Groundsure report date between 1862 and 2024.

3.2 Site and Surrounding Area History

Table 3-1 presents a summary of the main features present on and within approximately 250 m radius of the Site.

Table 3-1 Summary of Historical Mapping

Date/s	Key Features on-site	Key Features off-site
1862 – 1863 (1:10,560)	• The Site is undeveloped agricultural land; • Two wells are identified within the western portion of the Site; • Minor roads and tracks are present within the Site boundary; and • Minor surface water courses traverse the Site.	• Two wells are located in the surrounding area. One located approximately 80 m south and the other 115 m southwest; • A river is present approximately 180 m east of the Site; and • A road comprises the easternmost Site boundary.
1888-1915 (OS Six Inch, *National Library of Scotland*)	• Weir within the centre of the Site.	• Grinnan Hill Fort, Glassick village, Silverton village, Greenhaugh village, Keirallan House are shown at approximately 121 m north, 215 m southwest, 230 m northeast, 100 m northeast and 140 m south of the Site, respectively.
1901 (1:10,560)	• The Site area remains unchanged.	• Gravel pit is located 140 m to the north of the Site; • Sand pit is located 200 m to the south of the Site; and • The river to the east is named as the River Knaik
1954 (1:10,560)	• Pylons traverse the eastern section of the Site in a northeast-southwest direction.	• The wider Site remains unchanged; and • Grinnan Hill Fort now as ‘Ancient Earthwork’.
1977 - 1978 (1:10,560)	• The Site remains unchanged; and • The watercourse within which the weir is located is named as the Keir Burn.	• A well is located 240 m southwest of the Site while other historical wells are no longer marked; • Sewage works is located 140 m to the northeast of the Site; • The residential settlement of Braco to the north of the Site has expanded and is now within 250 m of the Site; • A Roman Road (course of) is recorded approximately 120 m east of the Site; and • Sand pit is no longer recorded.
2001 (1:10,560)	• The Site remains unchanged.	• The wider Site remains unchanged.
2010 (1:10,000)	• The Site remains unchanged.	• New cemetery at approximately 125 m east of the Site. • Sewage Works is no longer recorded.
2024 (1:10,560)	• The Site remains unchanged.	• The Roman Road is no longer recorded.

In summary, the Site has been largely undeveloped since the first available historical map. Small residential properties have been located within the vicinity of the Site, served by various wells in the area. The settlement of Braco expands into the vicinity of the site between the 1950s and 1970s. Historical and present-day features of interest have been identified in the surrounding area of the site, including historical sewage works, gravel pits and sand pits.

3.3 Summary of Potential Historical Contamination Sources

This section summarises potential contamination on-site and in the vicinity associated with historical features identified in **Section 3.2**. These include:

- **Agricultural land** (on-site), with potential for contaminants such as pesticides and herbicides, pathogens, metals and metalloids;
- **Sewage treatment works** (off-site), with potential for contaminants such as metals, inorganic compounds, TPH, PCBs, micro-organic pathogens, treatment chemicals (including ferric chloride, calcium oxide and aluminium chlorohydrate), asbestos;
- **Cemetery** (off-site), with potential for contaminants such as ammoniacal nitrogen, nitrite, nitrate, sulphate, metals, pathogens, formaldehyde;
- **Made Ground** associated with the infilling of gravel / sand pits (off-site), construction of power poles (on-site), construction of access roads (on-site/off-site), sewage works (off-site), construction of villages (off-site) and weir (on-site). These features could have the potential for contaminants such as metals and inorganic compounds, polycyclic aromatic hydrocarbons (PAHs), petroleum hydrocarbons (TPH) including benzene, toluene, ethylbenzene, xylene (BTEX) and methyl-tert-butyl-ether (MTBE), semi volatile organic compounds (SVOCs), volatile organic compounds (VOCs), sulphates, sulphides, cyanides, phenols, asbestos / asbestos containing materials (ACM); and
- **Potential ground gas** generation from made ground, cemetery and infilled sand pit (on-site and off-site).

4. Environmental Setting

4.1 Introduction

The environmental setting including the topography, geology, hydrogeology and hydrology are the key factors that influence the way in which contaminants in the soil or groundwater can be transported on or off site, and also the way in which contamination can affect applicable receptors including the water environment and users of the Site and surrounding areas.

The environmental setting of the Site has been assessed by making reference to the information sources detailed in **Section 1.5**.

4.2 Hydrology

4.2.1 Surface Water Features

The SEPA Water Environment Hub[4], the Groundsure report and other publicly available sources have been reviewed to identify relevant hydrological features on-site and in the surrounding area. The hydrology of the Site and surrounding area is summarised in **Table 4-1** below.

Table 4-1 Summary of On-site and Surrounding Area Hydrology

Feature	Distance & Direction*	Flow Direction	Description
Bullie Burn (ID: 4605) / Keir Burn	On-site	South	The waterway is part of the Allan Water catchment of the Scotland River basin district. The main stem is approximately 10.8 km in length. The overall condition of the waterway is 'moderate' due to the 'high' water quality, water flow, access for fish migration and freedom from invasive species and 'moderate' physical condition. By 2027 the river condition is still expected to be reported as 'moderate'.
Several Unnamed Drains	On-site	N/A	Several unnamed water courses are identified on the SEPA water environment hub but have no classifications.
Unnamed Ponds	180 m west	N/A	Unnamed ponds are identified on the SEPA water environment hub but have no classifications.
River Knaik (ID: 4606)	180 m east	South	The waterway is part of the Allan Water catchment of the Scotland River basin district. The main stem is approximately 15.5 km in length. The overall condition of the waterway is 'good' due to the 'high' water quality, water flows, access for fish migration and freedom from invasive species.
Feddal Burn	250 m south	East	Feddal Burn is identified on the SEPA water environment hub[4] but has no classifications.
Mill Burn	260 m west	Southeast	Mill Burn is identified on the SEPA water environment hub but has no classifications.
Allan Water (ID: 6833)	1 km south	West	The waterway is part of the Allan Water catchment of the Scotland River basin district. The portion south of the site, for which both the Bullie Burn and River Knaik flow into, is classified by SEPA as part of the Greenloaning to Dunblane section of the river. The main stem is approximately 15.8 km in length. The overall condition of the waterway is 'good ecological potential' due to the 'high' water quality and freedom from invasive species, 'good' water flow and physical condition as well as 'moderate' access for fish migration. By 2027 the river condition is expected to be reported as 'good ecological potential'. The waterbody is designated as heavily modified. The upstream portion of the Allan Water (source to Greenloaning) is 11.8 km in length, a heavily modified water body with 'moderate ecological potential'.

**All distance measured at closest point to the Site.*

Bullie Burn / Keir Burn, River Knaik, Feddal Burn and several unnamed ponds and drains are likely to be receptors as they are located on-site or within the immediate surrounding area. Allan Water is located

approximately 1 km south of the Site. Due to the significant distance from the Site, there is expected to be a low likelihood of impact on this waterway directly, but both the Bullie Burn and the River Knaik are both tributaries of Allan Water.

4.3 Geology

4.3.1 Published Geology

The published BGS 1:50,000 scale geological map (39E, Alloa, 1974) and the BGS Onshore Geoindex[3] have been reviewed along with the Groundsure Geo-Insight Report (**Appendix C Groundsure Report**) to determine the published geology underlying the Site.

Table 4-2 Geological Succession from Published Mapping

Group	Stratum	Published Description	Approx Thickness (m)
Superficial Deposits	**Peat** Present at approximately 830 m northwest of the Site.	*"Partially decomposed mass of semi-carbonized vegetation which has grown under waterlogged, anaerobic conditions, usually in bogs or swamps"*	N/A
	River Terrace Deposits Present at approximately 410 m east of the Site.	*"Sand and gravel, locally with lenses of silt, clay or peat".*	N/A
	Alluvium Present within the eastern portion of the Site, and at 260 m southwest.	*"Soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel."*	N/A
	Glaciofluvial Ice Contact Deposits Present in the west of the Site.	*"Sand and gravel, locally with lenses of silt, clay and organic material"*	N/A
	Glaciofluvial Sheet Deposits Present within the north-centre of the Site.	*"Sand and gravel, locally with lenses of silt, clay or organic material"*	N/A
	Devensian Till Present at approximately 210 m north of the Site.	*"Clay, sand, gravel, and boulders varying widely in size and shape"*	N/A
Bedrock	**Dunblane Sandstone Member** Indicated to be present beneath the entire Site.	"*Purple and brown, medium- and coarse-grained sandstones, subsidiary purple mudstones and rare pebbly sandstone beds.*"	About 750 m thick.

An extract of the BGS map for the site is included as **Plate 1 and 2** below.

There are no BGS designated areas of Made Ground or artificial ground recorded beneath the Site or within the surrounding area. Although no Made Ground is shown on published BGS mapping of the Site and within 1 km, localised Made Ground may be present within the Site associated with roads, tracks, construction of weirs etc.

The BGS 1:50,000 Drift paper map below shows Glacial Sand and Gravel, Boulder Clay and Alluvium of flood plains and undifferentiated alluvium to be On-Site. However, the BGS Geoindex reclassified the superficial geology as alluvium, Devensian till, glaciofluvial sheet deposits and glaciofluvial ice contact deposits. For the avoidance of doubt, this study will refer to the re-classification presented on the BGS Geo-index for superficial geology.

The BGS 1:50,000 Solid paper map below shows Dunblane Formation to be on-Site. However, the BGS Geoindex reclassified the bedrock geology as Dunblane Sandstone Member. For the avoidance of doubt, this study will refer to the re-classification presented on the BGS Geo-index for bedrock geology.

The bedrock is disrupted by two inferred faults of unknown displacement at approximately 510 m northeast of the Site.

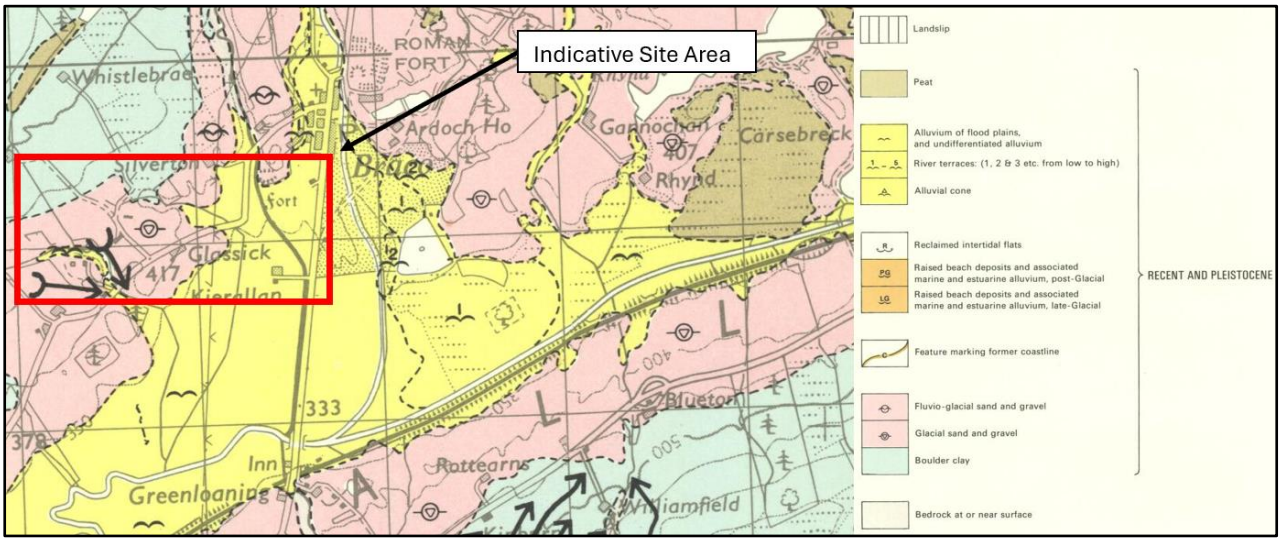

Plate 1 Superficial Geology

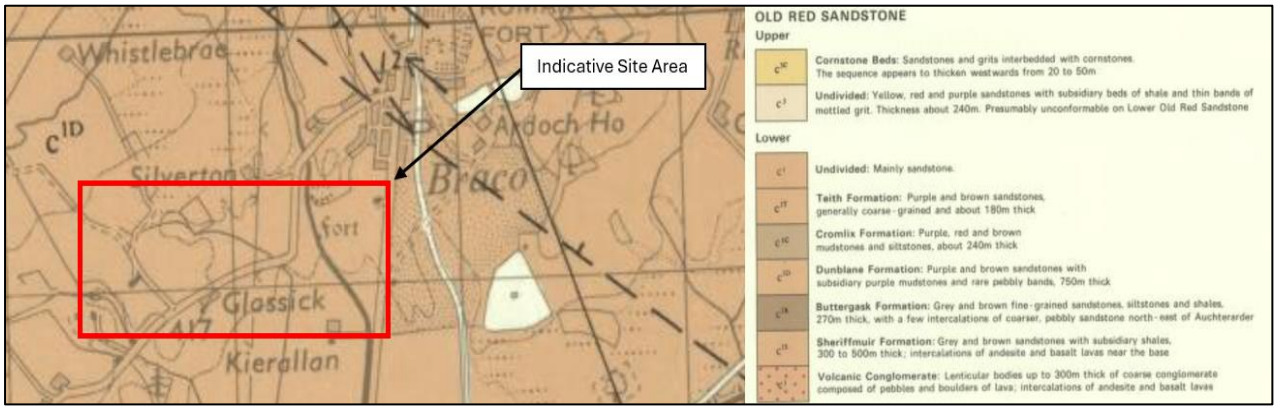

Plate 2 Bedrock Geology

The eastern portion of the Site's underlying superficial geology predominately comprises Alluvium. Due to the high percentage of fines within the superficial geology, it is anticipated that the ability for contaminant mobility is reduced in comparison to granular geologies. Areas where gravel and sands could be present within this portion of the Site may allow for preferential pathways for contaminant migration (if present).

The western portion of the Site's underlying superficial geology predominately comprises Glaciofluvial Ice Contact Deposits. The granular nature of the superficial deposits beneath the Site could result in higher contaminant mobility.

4.3.2 BGS Historical Borehole Records

AECOM has searched the BGS historical borehole record database for relevant records relating to the Site and immediate surrounding area. 6 no. boreholes located within 1 km of the Site have been referenced in producing this report and are summarised in **Table 4-3** below.

Table 4-3 Summary of BGS Historical Borehole Records

Borehole No.	Strata	Depths	Description
NN80NW11 – at approximately 160 m south of the Site.	Topsoil	0.00 m to 0.40 m below ground level (bgl)	*N/A*
	Alluvium	0.40 m to 0.70 m bgl	Silty CLAY
		0.70 m to 1.70 m bgl	*Clayey pebbly SAND with gravels*

Borehole No.	Strata	Depths	Description
		1.70 m to 6.40 m bgl	*GRAVEL (coarse to fine)*
	Glaciolacustrine Deposits	6.40 m to 21.40 m bgl	*Clayey SILT*
NN80NW10064/BH1 – located 150 m east of the Site	Topsoil	0.00 m to 0.60 m bgl	Clayey silty SAND with gravel, cobble and roots
	Alluvium	0.60 m to 2.40 m bgl	Clayey sandy GRAVEL with cobbles
		2.40 m to 5.00 m bgl	Clayey sandy GRAVEL with cobbles and occasional boulders
		5.00 m to 6.40 m bgl	SAND and GRAVEL
		6.40 m to 7.95 m bgl	Sandy GRAVEL
	Bedrock	7.95 m to 8.30 m bgl	Decomposed SANDSTONE
		8.30 m to 10.00 m bgl	SANDSTONE
NN80NW10064/TP2 – located 150 m east of the Site	Topsoil	0.00 m to 0.70 m bgl	Gravelly, silty and clayey SAND
	Alluvium	0.70 m to 1.70 m bgl	SAND with gravel and cobbles
		1.7 m to 2.50 m bgl	Sandy GRAVEL with cobbles
NN80NW8 -located at approximately 300 m south of the Site	Topsoil	0.00 m to 0.20 m bgl	N/A
	Glaciofluvial Ice Contact Deposits	0.20 m to 6.50 m bgl	Clayey sandy GRAVEL
		6.50 m to 12.70 m bgl	Clayey pebbly SAND
		12.70 m to 14.80 m bgl	very clayey SAND
	Till	14.80 m to 16.30 m bgl	CLAY, sandy, gravelly, light brown
	Bedrock	16.30 m to 16.90 m bgl	SANDSTONE
NN80NW19 -located at 670 m west of the Site	Topsoil	0.00 m to 0.50 m bgl	N/A
	Till	0.50 m to 1.70 m bgl	CLAY, gravelly, sandy with numerous angular fragments of weathered sandstone
NN80NW15- Located 840 m southeast of the Site	Topsoil	0.20 m to 1.80 m bgl	
	Alluvium / Glaciolacustrine deposits	1.80 m to 8.00 m bgl	GRAVEL with cobbles, CLAY containing rare sand seams
	Till	8.00 m to 10.40 m bgl	CLAY, sandy, gravelly, stiff, reddish brown

The identified historical boreholes reviewed as part of this desk study appear to align with the published BGS geological maps.

Copies of these exploratory hole records are included as **Appendix D Historical Borehole Logs**.

4.3.3 Quarrying

Table 4-4 presents the available information on quarrying operations, past and present that have taken place within 250 m of the Site.

Table 4-4 Quarrying (<250 m of Site)

National Grid Reference	Distance and Direction from Site	Name	Operator	Dates	Status/ Material Quarried
NN 82734 08918	200 m south	Glassick Sand Pit	Unknown	1901[11] - 1954	Ceased/Sand
NN 82305 09220	130 m northwest	Nether Braco & Silverton Farms	Unknown	Unknown	Ceased/Sand & Gravel
NN 83402 09459	400 m northeast	Braco	Unknown	1888-	Ceased
NN 83155 10094	820 m north	North Silverton	Unknown	Unknown	Ceased
NN 83517 10103	920 m north	Ardoch Bridge	Unknown	Unknown	Ceased

Source: Groundsure Report Ref: GSIP-2024-14502-17022 and BGS Onshore Geoindex

4.4 Hydrogeology

4.4.1 Aquifer Classification & Groundwater Vulnerability

Groundwater bodies are classified by SEPA under the Water Framework Directive, whereby water bodies in Scotland are classed as High, Good, Moderate, Poor or Bad. A search of SEPA's online database[4] was conducted regarding the groundwater quality beneath the Site. Groundwater within the Site falls within the 'Dunblane' groundwater area (SEPA ID: 150628) which classified both water quality 'Good' and the quantitative status as 'Poor'. Overall, the condition as of 2023 is listed as 'Poor'.

The Groundsure report lists the bedrock aquifer as part of the Arbuthnott-Garvock Group and describes it as a moderately productive aquifer.

4.4.2 Preliminary Hydrogeological Model and Flow Direction

Groundwater flow direction within the shallow superficial aquifer will likely be influenced by the local topography. However, the nature and extent of groundwater bodies within the area is unknown, therefore groundwater flow direction should be further characterised by ground investigation if required.

[11] National Library of Scotland shows this from 1888

5. Regulatory Information and Consultation

5.1 Introduction

The key relevant features that characterise the Site and surrounding area are summarised in this section, along with an indication of the risk to the land quality of the Site. Generally, any regulated activities within 250 m of the Site could, depending upon their nature, represent potential off-site sources of contamination.

5.2 Regulatory Database Review

Table 5-1 summarises information obtained from the regulatory database information contained in the Groundsure Report (**Appendix C Groundsure Report**). The Groundsure report was purchased for another area of the wider development, and therefore all entries are approximated and may not be specific to this Site. All data suppliers are referenced in the Groundsure Report.

Regulatory information is excluded from the table below where it is not within the specified distances, where there is no information for the given topic or where entries are duplicated.

Table 5-1 Summary of Regulatory Information

Subject	Number present		Details
	On-Site	0-250 m	
Licensed Waste Management Facilities and Industrial Land Uses			
Sand Pit	-	1	Sand pit (1901 – 1954)
Sensitive Land Uses			
Designated Ancient Woodland	-	1	Long established (of plantation origin)

A review of the information provided within the Groundsure Report identifies sources and receptors around the site boundaries. The information provided for the Site identifies a sand pit located in the area. Additionally, it identifies a sensitive receptor (ancient woodland) adjacent to the Site.

5.3 Regulatory Consultation

5.3.1 Local Authority Contaminated Land Officer

The Environmental Health Team at Perth and Kinross Council was contacted to request pertinent information on the environmental conditions of the Site. The response provided in **Appendix E Council Contamination Response** dated 6 March 2025 confirmed the following:

- No current or historical environmental problems have been recorded at the Site;
- There are currently no contaminated land designations within the Site; and
- No historical landfills are recorded on or within 250 m of the Site.

Council records do not provide any additional information that is pertinent to the Site.

5.3.2 Scottish Environment Protection Agency (SEPA)

SEPA was contacted to request pertinent information on the environmental conditions of the Site on 20 February 2025. At the time of writing, a response is still awaited.

5.3.3 Planning Information

The Perth and Kinross Council web-based planning portal was reviewed to identify whether there are existing planning conditions which relate to the Site. The only application listed within the online planning portal was for the works outlined in this report, as discussed in **Section 1.3**.

5.3.4 Scottish Environment Protection Agency (SEPA) Flooding Data

The SEPA Flood Maps[5] website was accessed on 18 February 2025 and confirmed that the following flooding risks are recorded for the Site:

- **Flooding from Rivers** – A large portion of the eastern extent of the Site is within an area of designated flood risk from river flooding. This area is identified as having areas of low (0.1% chance of flooding), medium (0.5% chance of flooding) and high likelihood (10% chance of flooding) of river flooding along and within the vicinity of the Kier Burn. The remainder of the site is not identified as an area of river flooding. This is also confirmed by the Groundsure Report (**Appendix C Groundsure Report**);
- **Surface Water Flooding** – the majority of the Site is not in an area of designated flood risk from surface water flooding. Small, isolated areas within the eastern portion of the Site are identified as having a risk from surface water flooding. These isolated areas range from 0.5% to 0.1% chance of flooding. In the field to the northwest of the Site is shown to have a high risk from surface flooding (10% chance of flooding). This is also confirmed by the Groundsure Report (**Appendix C Groundsure Report**);
- **Coastal Flooding** - the Site is not in an area of designated flood risk from coastal flooding, suggesting there is no specific likelihood of coastal flooding identified in the area. This is also confirmed by the Groundsure Report (**Appendix C Groundsure Report**);
- **Groundwater Flooding** – the Site is in an area of designated flood risk from groundwater flooding, suggesting there is a low likelihood of groundwater flooding within the northeastern corner of the Site and a moderate likelihood of groundwater flooding across the remaining site area. This is also confirmed by the Groundsure Report (**Appendix C Groundsure Report**).

A formal flood risk assessment is outside the scope of this report.

5.3.5 Mining Remediation Authority and Preliminary Mine Gas Risks

AECOM have reviewed the Mining Remediation Authority Map Viewer[2], which indicates that the Site is not located within a Coal Mining Reporting Area. This indicates that risks from historical coal mining are low, with no further assessment required.

5.3.6 Unexploded Ordnance

To assess the potential risks from Unexploded Ordnance (UXO) at the Site, the Zetica Unexploded Bomb Risk Map[7] was used on 18 February 2025. The Zetica Bomb Risk Map for the Site and surrounding area indicated that the Site sits within a Low-risk area, which is defined by Zetica as an "*area indicated as having 15 bombs per 1000 acres or less*".

A Zetica Pre-Desk Study Assessment (PDSA) has identified World War II (WWII) military activities on or affecting the Site. The extended assessment is in **Appendix F Zetica UXO Risk Mapping/ Preliminary UXO Desktop Report**. It is recommended that a detailed desk study is commissioned to assess, and potentially zone, the UXO hazard level on the Site.

Table 5-2 Summary of WWII Military Activities On or Affecting the Site

Date	On or Affecting the Site
Pre-WWI Military Activity	During the early 1900s, Whitestone ranges and an area of open land known as Sheriff Muir were used for military training.
WWI Military Activity	None Identified
WWI Bombing	
WWII Military Activity on or affecting the Site	During WWII, the Glen Artney Corry Our range was established near the Site. Records show artillery and tanks would fire across the Site to the neighbouring Sheriff Muir range. By 1945, both the Corry Our and Sheriff Muir ranges were closed. One pillbox was established on the Site, it has since been removed.
WWII Bombing	During WWII the Site was located in the Perth Landward Area (LA), which officially recorded 171No. High Explosive (HE) bombs with a bombing density of 1.1 bombs per 405 ha. No readily available records have been found to indicate that the Site was bombed.

Date	On or Affecting the Site
Post-WWII Military Activity on or Affecting the Site	None identified on the Site.

5.4 Radon

The UK Health Security Agency's UK Radon website[8] was reviewed on 18 February 2025 to determine potential radon risks for the Site.

According to the website, the Site is located within an area where less than 1% of homes are above the action level for radon gas.

The above is also confirmed by the Groundsure Report (**Appendix C Groundsure Report**). It is therefore anticipated that radon protective measures will not be necessary should the construction of any new buildings within the Site be undertaken (none are proposed currently).

6. Review of Historical Reports

6.1 Introduction

Information provided to AECOM related to the subject Site from previous ground investigation reports have been reviewed as part of this study. Relevant information relating to the Site, geological or land quality status has been subject to a review and summary as part of this report.

6.2 Third Party Information Review

Balfour Beatty (the Client's Principal Contractor) commissioned Raeburn Drilling & Geotechnical Limited (RDG) to undertake a ground investigation on the Site. A factual ground investigation report was provided to AECOM for review. A copy of this report is available in **Appendix G Historical Reports**. The objective of the works was to provide information on the ground conditions for design and construction of the proposed development and in relation to determine any geochemical contamination of the Site. The site work was carried out between 15 October and 25 October 2024, in accordance with EN1997-2:2007[27], BS5930[26], BS10175[28] and in house – procedures. Additionally, three rounds of ground gas monitoring was undertaken between 21 November 2024 and 10 December 2024.

- The ground investigation comprised the following:
  - 2Nos boreholes (BH01, BH02) sunk by rota-sonic and core drilling methods;
  - 7Nos boreholes (WS01-WS07) undertaken by continuous percussion boring;
  - 22Nos of trial pits excavated by machine; and
  - 4Nos pavement cores.
- The following ground conditions were recorded:
  - Topsoil was encountered in BH01, BH02, WS01-WS07, between 0 m bgl and 0.50 m bgl.
  - Natural superficial deposits encountered in all locations (BH01, BH02, WS01-WS07, TP01-TP22) comprised a combination of clay, sand, gravel and silt between 0m bgl-16.50 m bgl.
  - Bedrock of sandstone and basalt was encountered in two locations (BH01, BH02) between 13.60-17.70 m bgl.
  - Made Ground was not encountered.
  - Groundwater was encountered as either moderate inflow, seepage, or rapid ingress in 21 Nos of investigated locations between 1.00 m bgl (TP17) and 2.50 m bgl (WS01, TP20).
- No visual or olfactory evidence of contamination was noted during the ground investigation.

- Three rounds of ground gas monitoring (including groundwater level monitoring) were undertaken on Site within eight locations, with atmospheric pressure ranging between 980 and 1027 mbar. The wells were screened in superficial deposits, to depths between 0.50 m bgl-10.00 m bgl. The following measurements (peak levels) were recorded:
  - Methane (CH_4) at 0% v/v (by volume) in all locations;
  - Carbon dioxide (CO_2) between 0 % v/v and 6.20% v/v (WS02);
  - Oxygen (O_2) between minimum 12.10% v/v (BH01) and 20.70% v/v (WS06);
  - Hydrogen sulphide (H_2S) as 0 ppm in all locations;
  - Carbon monoxide (CO) between 0 ppm and 5 ppm (BH01); and
  - Groundwater levels were recorded in all 8 locations between ground level and 3.30 m bgl (BH01).
- The laboratory geo-environmental testing was carried out by Terra Tek Limited (Trading as Igne) and included the following testing: Metals, Inorganic Suite, Total Petroleum Hydrocarbon Criteria Working Group / Volatile Petroleum Hydrocarbon Criteria Working Group (TPHCWG / VPHCWG), Phenol, Organic Matter, pH, Sulfate, Polyaromatic Hydrocarbons (PAH), Asbestos. No Waste Acceptance Criteria (WAC) testing was undertaken.
- Chemical contamination testing was carried out on 36 samples from natural deposits.
- Chemical results were generally close to or below the method detection limit, except for generally higher total chromium, arsenic, boron, zinc, lead, nickel, copper and sulphate. Whilst AECOM have not undertaken a formal quantitative risk assessment of the data provided for review, the concentrations do not appear to indicate contamination impacts for a road end use.
- Asbestos containing materials was not identified in any of the 35 soil samples analysed.

7. Conceptual Site Model and Risk Assessment

7.1 Introduction

The preliminary CSM has been developed to identify potentially complete contaminant linkages that may require further investigation to assess their existence and / or potential significance. The potential sources of contamination on or in the vicinity of the Site, receptors on or near the Site, and pathways on or near the Site are discussed within the following sub-sections.

A summary of the applicable legislative and planning framework, and AECOM's approach to assessment used in the following sections is presented in **Appendix A Approach to Reporting**.

7.2 Sources of Potential Contamination

Based on the site setting, history and land-uses described in preceding sections, the following sources of contamination and contaminants of potential concern (CoPC) listed in **Table 7-1** have been identified.

The CoPC are based on information provided in the Department of Environment Industry Profiles, known contamination identified at the Site and AECOM's industry experience.

Table 7-1 Potential Sources of Contamination

Source	Description	CoPC
Agricultural (On-site and Off-site)	Across both the BESS and BNG proposed Sites.	Metals, Herbicides, Pesticides and TPH.
Made ground (On-site and Off-site)	Associated with the historical infilled pits (off-site, 140m north and 200m south) and construction of power poles and roads (on-site/ off-site, within 250m north, east, south and west), villages (off-site, within 250m north and south), weir (on-site, centre), sewage works (off-site, 140m northeast).	Metals and inorganic compounds, pH, ground gas, PAHs, TPH including Benzene, Toluene, Ethylbenzene and Xylene (BTEX) and Methyl tert-butyl ether (MTBE), SVOCs, VOCs, sulphates, sulphides, cyanides, phenols, ACMs
Mine gas and ground gas from former infilling (Off-site)	Associated with the historical infilled pits (140m north and 200m south of the Site).	Ground gases (including methane and carbon dioxide)
Historical Sewage Works (Off-site)	Historical sewage works located 140m the northeast of the Site.	Metals, inorganic compounds, TPH, PCBs, micro-organic pathogens, treatment chemicals (including ferric chloride, calcium oxide and aluminium chlorohydrate), asbestos.
Cemetery (Off-site)	Current cemetery at 125 m east of the Site	Ammoniacal nitrogen, nitrite, nitrate, sulphate, metals, pathogens, formaldehyde, ground gas

7.2.1 Ground Gas Sources

The identified sources of ground gas within **Section 8.2** above have been further characterised in **Table 7-2** below using BS 8576:2013 [12] – Figure 6 to determine the ground gas generation potential of the sources.

Table 7-2 Potential Sources of Contamination

Source	BS 8576 Ground Gas Generation Potential	Justification
Made Ground	Very Low	Potential made ground deposits could be present on Site but are classified as having a 'very low' ground gas generation potential by BS 8576:2013[12] and are therefore unlikely to represent a significant source of ground gas generation.

[12] British Standards Institution, 2025. *BS 8576:2013 Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)*

7.3 Potential Receptors

Potential receptors associated with the Site are shown on **Table 7-3.**

Table 7-3 Potential Receptors

Receptor Group	Receptor	Description
Human Health	Construction and maintenance workers	Workers involved in remediation and construction, as well as maintenance workers and grounds keepers for the new development.
	Site users / Site visitors	Site visitors who come to the Site for a small period time, as well as staff who are based on Site for several hours a day.
	Adjacent site users	Potential future residential dwellings in the immediate area surrounding the Site.
Water Environment	Superficial and bedrock aquifers	Strathallan Sand and Gravel aquifer beneath superficial deposits and Arbuthnott-Garvock group bedrock aquifer.
	Surface waters	Bullie Burn/Keir Burn and several unnamed drains on site and River Knaik, Feddal Burn, Mill Burn and several unnamed ponds in the surrounding area.
Built Environment	Buildings & Infrastructure: Concrete	Concrete foundations of the proposed new development of the substation off-site.

7.4 Potential Pathways

Potential pathways associated with the proposed development are shown in **Table 7-4.**

Table 7-4 Potential Pathways

Pathway Group	Pathway
Human Health	Ingestion of soil and dust
	Inhalation of dust - indoor and outdoor
	Dermal contact
	Vapour intrusion and inhalation (excavations, confined spaces etc)
	Gas ingress (excavations, confined spaces etc) – explosive atmosphere
	Gas ingress (excavations, confined spaces etc) – inhalation
Water Environment	Leaching and vertical migration through unsaturated zone
	Lateral migration in groundwater
	Vertical migration in groundwater
	Direct run-off
	Baseflow from groundwater to surface water
	Migration via preferential pathways (services trenches, faults etc)
Built Environment	Gas intrusion (excavations, confined spaces etc) - explosion
	Direct contact - corrosion
	Plant uptake

7.5 Discounted Sources / Pathways / Receptors

The following sources, pathways and receptors are discounted from the CSM, with justification, are presented in **Table 7-5.**

Table 7-5 Discounted Sources / Pathways / Receptors

Group	Discounted Item	Justification
Source	Radon	Due to the low risk that radon is present on Site and the lack of proposed buildings as part of the development, radon has been excluded as a source of concern.
Receptors	Ancient Woodland	The most recent aerial image shows the ancient woodland is a much smaller area than shown on the Groundsure Report. Due to the distance from the Site (approximately 650 m) it has been discounted.
	Buildings & Infrastructure: Structures with enclosed spaces	As the Proposed Development includes no enclosed structures, this has been discounted.

7.6 Preliminary Risk Assessment

AECOM's approach to the preliminary risk assessment follows the guidance outlined in CIRIA C552 and is described in further detail in **Appendix A**.

The qualitative preliminary risk assessment of the possible linkages of the above sources, exposure and transport pathways and receptors is provided in the **Table 7-6** below.

Table 7-6 Summary of Preliminary CSM and Risk Assessment

Source	Receptor		Exposure Pathway	Probability	Consequence	Risk Category	Justification
On-site contamination source – historical agricultural land use	**Human Health – On-site**	Site Users and Site Visitors Post Development	Inhalation of contaminants in soil-derived dust and asbestos fibres.	Unlikely	Medium	**Low Risk**	Potential for encountering contamination is likely to be low or very low for the Site based on the land uses identified. The current and future site users are likely to be transient and will not stay on-site for long periods of time. The main potential contamination source is historical agricultural land use, which is not expected to represent a significant source of contamination within the Site. It is anticipated that the risk to current and future site users is low. Additionally, the probability of asbestos is considered unlikely within the Site due to the lack of buildings historically. This was confirmed by the 2024 Igne ground investigation.
			Dermal contact with and ingestion of contaminants in soil, soil-derived dust and water.	Unlikely	Medium	**Low Risk**	
			Inhalation of vapours.	Unlikely	Minor	**Very Low Risk**	
		Construction / Maintenance Workers	Inhalation of contaminants in soil-derived dust.	Low likelihood	Medium	**Moderate/Low Risk**	Construction workers could be exposed to sub-surface contaminants (if present) during construction works including during excavations. However, the use of appropriate Personal Protective Equipment (PPE) should mitigate against this risk. The presence of extensive contamination within these areas is unlikely but will require further investigation to validate.
			Dermal contact with and ingestion of contaminants in soil, soil-derived dust and water.	Low likelihood	Medium	**Moderate/Low Risk**	
			Inhalation of asbestos fibres.	Unlikely	Medium	**Low Risk**	
			Inhalation of vapours and / or ground gas.	Unlikely	Medium[13]	**Low Risk**	
	Human Health – Off-site	Third Party Neighbours	Inhalation of contaminants in soil, soil-derived dust and volatile vapours.	Unlikely	Medium	**Low Risk**	No potentially significant sources of ground gas have been identified at the Site.
			Inhalation of asbestos fibres.	Unlikely	Minor	**Very Low Risk**	
	Water Environment	Superficial and Bedrock Aquifers	Leaching of contaminants in the unsaturated zone and migration to groundwater in underlying aquifers.	Low Likelihood	Mild	**Low Risk**	Potentially significant contamination is not anticipated given the desk study findings. Potential for encountering contamination is likely to be low or very low within the Site based on the land uses identified. There is potential for localised contamination to be present from the Site's historical land use. Due to the high permeability of Glaciofluvial Deposits within the western portion of the Site, there is the potential for vertical migration towards groundwater if contamination were to be present.
			Contaminant migration in groundwater from superficial aquifer to the bedrock aquifer.	Low Likelihood	Mild	**Low Risk**	
		Surface Water Features inc. Bullie Burn / Keir Burn	Lateral migration of contaminated groundwater in superficial / bedrock aquifers with discharge to surface watercourses as base flow.	Likely	Mild	**Moderate / Low Risk**	Due to the short distance to the nearest surface water feature, it is likely that contaminants would migrate through surface waters if contamination were to be present. However, the presence of significant contamination is not considered likely.
			Discharge of contaminants entrained in surface water run-off followed by overland flow and discharge.	Likely	Mild	**Moderate / Low Risk**	
On-site contamination source – Made Ground	**Human Health – On-site**	Site Users and Site Visitors Post Development	Inhalation of contaminants in soil-derived dust and asbestos fibres.	Unlikely	Medium	**Low Risk**	Potential for encountering contamination is likely to be low or very low for the Site based on the land uses identified. The current and future site users are likely to be transient and will not stay on-site for long periods of time. Whilst there is the potential for exposure within areas of soft landscaping where localised Made Ground is present, limited potential sources of contamination have been identified. Furthermore, the 2024 Igne ground investigation did not identify made ground in any of the 31 locations investigated.
			Dermal contact with and ingestion of contaminants in soil, soil-derived dust and water.	Unlikely	Medium	**Low Risk**	
			Inhalation of vapours.	Unlikely	Minor	**Very Low Risk**	
		Construction / Maintenance Workers	Inhalation of contaminants in soil-derived dust. Inhalation of asbestos fibres.	Low likelihood	Medium	**Moderate/Low Risk**	Construction workers could be exposed to sub-surface contaminants during construction works including during excavations. However, the use of appropriate PPE should mitigate against this risk. The presence of extensive contamination within these areas is unlikely but will require further investigation to validate.
			Dermal contact with and ingestion of contaminants in soil, soil-derived dust and water.	Low likelihood	Medium	**Moderate/Low Risk**	
			Inhalation of vapours and / or ground gas in excavations / confined spaces	Unlikely	Medium	**Low Risk**	The risk to future site users from ground gas / vapour is considered to be low based on the public open space use. Ground gases / vapours can accumulate within confined spaces which could pose a risk to construction and / or maintenance workers and third-party neighbours, however deep excavations in relation to the construction of a haul track are not considered likely.
	Human Health – Off-site	Third Party Neighbours	Inhalation of contaminants in soil, soil-derived dust. Inhalation of asbestos fibres.	Unlikely	Medium	**Low Risk**	
			Inhalation of volatile vapours / ground gas.	Low likelihood	Medium	**Moderate/Low Risk**	
	Water Environment	Superficial and Bedrock Aquifers	Leaching of contaminants in the unsaturated zone and migration to groundwater in underlying aquifers.	Low likelihood	Medium	**Moderate/Low Risk**	Hydraulic continuity between shallow and deep groundwater is unknown. Mobile contaminants from on-site sources have the potential to leach into the bedrock aquifer causing potential pollution of the water environment. During the 2024 GI, groundwater was encountered between 1.00 m bgl and 2.50 m bgl (during drilling), and between 0.00 m bgl and 3.30 m bgl (during gas monitoring), excavations will likely reach groundwater, and dewatering may be required temporarily during construction. The eastern portion of the Site's underlying superficial geology predominately comprises cohesive Alluvium. This may limit the migration of contaminants vertically which may then migrate laterally causing pollution to wider water environment receptors.
			Contaminant migration in groundwater from superficial aquifer to the bedrock aquifer.	Low likelihood	Medium	**Moderate/Low Risk**	
		Surface Water Features inc. Bullie Burn / Keir Burn	Lateral migration of contaminated groundwater in superficial / bedrock aquifers with discharge to surface watercourses as base flow.	Low likelihood	Medium	**Moderate/Low Risk**	
			Discharge of contaminants entrained in surface water run-off followed by overland flow and discharge.	Likely	Medium	**Moderate Risk**	

[13] Source severity has been downgraded to 'Medium' as ground gas sources identified have a 'Low' ground gas generation potential and vapour sources are considered to be limited in potential concentration and extent. Therefore, ground gas sources are unlikely to generate significant concentrations capable of meeting the 'Severe' severity rating as defined in CIRIA C552. A severe rating has been assigned to mine gas based on the high gas emission potential derived from CL:AIRE guidance.

Source	Receptor		Exposure Pathway	Probability	Consequence	Risk Category	Justification
							The western portion of the Site's underlying superficial geology predominately comprises Glaciofluvial Deposits. The granular nature of the superficial deposits beneath the Site could result in higher contaminant mobility. This was also confirmed by the 2024 Igne ground investigation which identified the presence of clay, gravel and sand. Cohesive clay was present within BH01, BH02, WS03, WS05, WS06, TP20, whereas gravel and sands were present within all 31 investigated locations. Due to the short distance to the nearest surface water feature, it is likely that contaminants would migrate through surface waters if contamination were to be present. A higher (moderate) risk could be introduced from run-off towards surface water when excavating and stockpiling close to watercourses.
Off-Site contamination sources – historical sewage works/ Graveyard	**Human Health – On-site**	Site Users and Site Visitors Post Development	Inhalation of contaminants in soil-derived dust and asbestos fibres.	Unlikely	Mild	**Very Low Risk**	The presence of an historical sewage works within the vicinity of the Site may give rise to some contamination within the eastern portion of the Site. The sewage works was located approximately 200 m down hydraulic gradient of the Site, and as such it is considered unlikely that the Site will have been impacted by the presence of related contaminants.
			Dermal contact with and ingestion of contaminants in soil, soil-derived dust and water.	Unlikely	Mild	**Very Low Risk**	
			Inhalation of vapours.	Unlikely	Mild	**Very Low Risk**	
		Construction / Maintenance Workers	Inhalation of contaminants in soil-derived dust.	Low Likelihood	Medium	**Moderate / Low**	
			Dermal contact with and ingestion of contaminants in soil, soil-derived dust and water.	Low Likelihood	Medium	**Moderate / Low**	Construction workers could be exposed to localised sub-surface contaminants during construction works. However, the use of appropriate PPE should mitigate against this risk.
			Inhalation of asbestos fibres.	Low Likelihood	Medium	**Moderate / Low**	
			Inhalation of vapours and / or ground gas.	Low Likelihood	Medium	**Moderate / Low**	
Off-site contamination source – Made Ground and ground gas	**Human Health – On-site**	Site Users and Site Visitors Post Development	Inhalation of contaminants in soil-derived dust and asbestos fibres.	Unlikely	Minor	**Very Low Risk**	Due to the presence of historical sand and gravel pits within the surrounding area of the Site, there is a low likelihood of contamination migration onto the Site. The presence of contamination is expected to be limited to the boundary of these features and given the distance between them and the Site, the overall risk is considered to be low / very low.
			Dermal contact with and ingestion of contaminants in soil, soil-derived dust and water.	Unlikely	Minor	**Very Low Risk**	
			Inhalation of vapours.	Unlikely	Minor	**Very Low Risk**	
		Construction / Maintenance Workers	Inhalation of contaminants in soil-derived dust.	Low Likelihood	Mild	**Low Risk**	
			Dermal contact with and ingestion of contaminants in soil, soil-derived dust and water.	Low Likelihood	Mild	**Low Risk**	Construction workers could be exposed to localised sub-surface contaminants during construction works. However, the use of appropriate PPE should mitigate against this risk.
			Inhalation of asbestos fibres.	Low Likelihood	Mild	**Low Risk**	
			Inhalation of vapours and / or ground gas.	Low Likelihood	Mild	**Low Risk**	

8. Conclusions and Recommendations

8.1 Conclusions

The main potential on-site sources of contamination associated with the Site relates to the Site's long history as agricultural land and the presence of minor roadways and tracks. Agricultural land is unlikely to represent a significant source of contamination unless, for example, contaminated materials have been buried. Made Ground may be present, associated with roads and tracks within the Site. A Zetica Pre-Desk Study Assessment (PDSA) has identified World War II (WWII) military activities on or affecting the Site.

Additional features of interest in the area surrounding the Site include historical pits and sewage works. These features do pose a potential for contamination to the Site. However, as the contamination from these sources is expected to be limited in extent and unlikely to be able to migrate onto Site given the distance at which they are from Site. These features are therefore considered to represent low risks to the Proposed Development.

The Proposed Development includes for a large portion of hardstanding (access haul road). As such, the hardstanding reduces potential impacts to on-site human health receptors by severing pathways. The most sensitive receptors from land contamination are as considered as follows:

- Surface water features due to the proximity to the Site, it is likely that contaminants could migrate through surface waters if contamination is present; and
- Construction / Maintenance Workers via inhalation of vapours and / or ground gas in excavations / confined spaces as well as dermal contact with contaminated soil.

No potentially significant sources of ground gas have been identified within the Site or within the immediate surrounding area. Whilst there are a number of infilled pits, given the age of filling and / or distance for most of these the potential for gas migration towards the Site resulting in an impact is considered unlikely.
Based on the available desk study information and the proposed development, the Site is classified overall as having **Low risk** with respect to contaminated land.

8.2 Recommendations

A geo-environmental ground investigation is not required for the Site but could be undertaken with due consideration of the requirements of BS 10175:2011 (+A2 2017)[14] to support the development design (including earthworks and foundation design) and to confirm potential risks associated with / mitigation requirements of potential low level contamination sources. The geotechnical elements of the investigation should be designed with consideration of BS EN 1997-1:2004[15], BS EN 1997-2:2007[16] (Eurocode 7: Geotechnical Design – Parts 1 and 2) and BS 5930:1999[17].

If a ground investigation is to be completed, it is recommended that the ground investigation includes the following:

- Characterisation of the ground conditions to ascertain more certainty in geotechnical and contaminated land assessments;
- Sampling and analysis of soil, groundwater and leachate to confirm the presence / absence of contaminants;
- Ground gas and groundwater monitoring to confirm the presence / absence of contamination and elevated ground gas concentrations;
- Preparation of a preliminary engineering assessment for the Site; and,
- Preparation of a quantitative assessment of risks to human health and controlled waters.

It is recommended that the ground investigation be designed in accordance with the UK Specification for Ground Investigation (third edition)[18].

[14] British Standards Institution, 2017. *BS 10175:2011+A2:2017 Investigation of potentially contaminated sites. Code of practice. Code of practice*
[15] British Standards Institution, 2004. *BS EN 1997-1:2004 Eurocode 7: Geotechnical design- Part 1: General rules*
[16] British Standards Institution, 2007. *BS EN 1997-2:2007 Eurocode 7. Geotechnical design. Ground investigation and testing*
[17] British Standards Institution, 1999. *BS 5930:1999+A2:2010 Code of practice for site investigations*
[18] Association of Geotechnical & Geonvironmental Specialists, 2022. *UK Specification for Ground Investigation* (third edition)

Prior to commencing the GI works or subsequent construction works, Zetica has recommended that a detailed desk study is commissioned to assess, and potentially zone, the UXO hazard level on the Site.

Appendix A Approach to Reporting

A.1 Legislative Context and Guidance

Where this report relates to existing or proposed planning application, it considers the contents of the Town and Country Planning Act 1990[19] (as amended), the National Planning Framework 4 (NPF4)[20] and considers the potential implications of Part 2A of the Environmental Protection Act 1990[21], the associated Contaminated Land: Statutory Guidance Edition 2[22] and the Planning Advice Notice 33[23].

This report has been prepared in general accordance with the technical guidance and procedures described in the UK Government guidance Land Contamination: Risk Management (LCRM)[24] and its predecessor, Model Procedures for the Management of Land Contamination, Contaminated Land Report (CLR) 11[25], BS 5930:2015 (as amended)[26] , BS:EN 1997[27], BS 10175:2011[28] and Land Contamination and Development – Guidance for Assessing and Addressing Land Contamination Issues to Meet the Requirements of Contaminated Land Regulators in Scotland[29]. We understand that at the time of writing, SEPA and the Scottish Government have not yet formally made their position clear on the published LCRM guidance. Given that the methodology in the LCRM guidance is essentially the same as that in CLR11, the key difference being some of the terminology used, AECOM has adopted the more recent guidance in this assessment.

A.2 Historical Map Review

AECOM notes that only indicative map scales are provided. Where dates are stated, these refer to the dates of maps on which the features are present, have changed use or are no longer annotated, and do not necessarily refer to the exact dates of existence of a particular feature. Development that may have occurred between map editions is recorded as occurring on the latter published map, hence there are some limitations to the accuracy to the date of development unless supplementary evidence is available.

A.3 Conceptual Site Model Derivation

The CSM is aimed at identifying possible risks, if any, arising from substances used or deposited on-site, or from other sources of land contamination. Both past and current potentially contaminative land uses have been considered. It is based on the proposed site redevelopment described in **Section 1** of this report.

Assessment Framework

The Site, in terms of potential land contamination, will be regulated by the Local Authority under the Town and Country Planning Act 1990[19], taking account of the NPF4[20] , with the SEPA, NatureScot and Historic Environment Scotland acting as potential statutory consultees.

Environmental liabilities can arise through provisions contained within statutory legislation including Part 2A of the Environmental Protection Act 1990[21], the Environmental Damage (Prevention and Remediation) Regulations 2009[30], the Water Resources Act 1991[31], the Groundwater Regulations 2009 and the Water Act 2003[32].

Current best practice recommends that the determination of health hazards due to contaminated land is based on the principle of risk assessment, as outlined in the Contaminated Land: Statutory Guidance Edition 2[22] and LCRM[24] .

[19] UK.gov, 1990. *Town and Country Planning 1990*
[20] Scottish Government, 2023. *National Planning Framework 4*
[21] UK.gov, 1990. *Environmental Protection Act 1990*
[22] UK.gov, 2006. *Contaminated Land: Statutory Guidance Edition 2*
[23] Scottish Government, 2017. *Planning Advice Note 3: Development of Contaminated Land*
[24] UK.gov, 2020. *Land Contamination: Risk Management*
[25] Environment Agency, 2004. *Model Procedures for the Management of Land Contamination, Contaminated Land Report (CLR)*
[26] British Standards Institution, 2015. *BS 5930:2015 Code of Practice for Site Investigations*
[27] British Standards Institution, 1997. *BS:EN 1997 Eurocode 7 – Geotechnical Design*
[28] British Standards Institution, 2011. *BS 10175:2011 Investigation of Potentially Contaminated Sites – Code of Practice*
[29] McLellan, I, Ogilvie, K, Toal, L, Hamill, S & McIntosh, R, 2019. Land contamination and development: guidance for assessing and addressing land contamination issues to meet the requirements of contaminated land regulators in Scotland. 2.12 edn, Environmental Protection Scotland
[30] UK.gov, 2009. *Environmental Damage (Prevention and Remediation) Regulations 2009*
[31] UK,gov, 1991. *Water Resources Act 1991*
[32] UK.gov. *Groundwater Regulations 2009 and the Water Act 2003*

The “suitable for use” approach is adopted (as outlined in the Contaminated Land: Statutory Guidance Edition 2[22]) for the assessment of contaminated land where remedial measures are undertaken where unacceptable risks to human health or the environment are realised taking into account the use (or proposed use) of the land in question and the environmental setting.

The risk assessment process for environmental contaminants is based on a source-pathway-receptor analysis. These terms can be defined as follows:

- **Source:** hazardous substance that has the potential to cause adverse impacts;
- **Pathway:** route whereby a hazardous substance may come into contact with the receptor: examples include ingestion of contaminated soil and leaching of contaminants from soil into watercourses; and
- **Receptor:** target that may be affected by contamination: examples include human occupants/ users of Site, water resources (surface waters or groundwater), or structures.

For a risk to be present, there must be a relevant / viable contaminant linkage; i.e. a mechanism whereby a source impacts on a sensitive receptor via a pathway.

AECOM have determined the potential sources, pathways and receptors to assess potential risks/ liabilities and constraints associated with the site in its current condition prior to any proposed redevelopment. Risks associated with the proposed redevelopment have also been assessed based on the future land use scenario specified, including any potential sources of contamination, potential receptors and potential contaminant pathways identified during this desk-based assessment.

A.4 Approach to Risk Assessment

Current best practice recommends that the determination of hazards due to contaminated land is based on the principle of risk assessment, as outlined in the Environment Agency guidance[25] on LCRM[24].

For a risk to be present, there must be a viable contaminant linkage; i.e. a mechanism whereby a source impacts on a sensitive receptor via a pathway.

Assessments of risks associated with each of these contaminant linkages are discussed in the following sections.

Using criteria broadly based on those presented in the CIRIA C552, the magnitude of the risk associated with potential contamination at the Site has been assessed. To do this an estimate is made of:

- The magnitude of the potential consequence (i.e. severity); and
- The magnitude of probability (i.e. likelihood).

The severity of the risk is classified according to the criteria in **Table 8-1.**

Table 8-1 Description of Severity of Risk

Severity	Definition	Examples (as defined by C552)
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by Environmental Protection Act 1990[21], Part IIA. Short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Catastrophic damage to buildings / property. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem (note: the definitions of ecological systems Within the Draft Circular on Contaminated Land[33]).	• High concentrations of cyanide on the surface of an informal recreation area; • Major spillage of contaminants from site into controlled water; and • Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health ("significant harm" as defined in DETR 2000). Pollution of sensitive water resources (note: Water Resources Act contains no for considering significance of pollution). A significant change in a particular ecosystem, or organism forming part of such ecosystem. (note: the definitions of ecological systems within Draft Circular on Contaminated Land[33]).	• Concentrations of a contaminant from site exceed the generic, or site-specific assessment criteria; • Leaching of contaminants from a site to a major or minor aquifer; and • Death of a species within a designated nature reserve.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ("significant harm" as	• Pollution of non-classified groundwater; and

[33] DETR, 2000. *Draft Circular on Contaminated Land*

Severity	Definition	Examples (as defined by C552)
	defined in the Draft Circular on Contaminated Land[33]). Damage to sensitive buildings / structures / services or the environment.	• Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc). Easily repairable effects of damage to buildings, Structures and services.	• The presence of contaminants at such concentrations that protective equipment is required during site works; • The loss of plants in a landscaping scheme; and • Discoloration of concrete.

The probability of the risk occurring is classified according to the criteria in **Table 8-2.**

Table 8-2 Likelihood of Risk Occurrence

Likelihood	Definition	Example
High	There is a pollutant linkage and an event that either appears very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.	• The contaminant linkage exists or is very likely to exist in the short term, and / or may also be linked to visual / olfactory evidence of that linkage being present and active in some cases; and • The conditions are such that there is no foreseeable reason to suggest that a source-pathway-receptor linkage is not occurring and required mediums for a contamination source to pass through / within to reach a receptor are all present.
Likely	There is pollutant linkage and all the elements are present and in the right place which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.	• The conditions are such that there are very few foreseeable reasons to suggest that a source-pathway-receptor linkage is not occurring, and that all or most of the required mediums for a contamination source to pass through / within to each a receptor are present.
Low Likelihood	There is pollutant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a long period such an event would take place, and is less likely in the shorter term.	• The source, pathway and receptor linkage may exist and it is possible that contamination could reach a receptor in certain circumstances. The site conditions indicate that there are limiting factors in the pathway mediums / generation potential of the source / or presence of the receptor.
Unlikely	There is pollutant linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.	• The source, pathway and receptor may exist in certain circumstances, but the contaminant linkage is improbable in the short term and in the long term.

An overall evaluation of the level of risk is gained from a comparison of the severity and probability, as shown in **Table 8-3.**

Table 8-3 Risk based on Comparison of Likelihood and Severity

		Severity			
		SEVERE	**MEDIUM**	**MILD**	**MINOR**
Likelihood	**HIGH**	Very High	High	Moderate	Moderate / Low
	LIKELY	High	Moderate	Moderate / Low	Low
	LOW	Moderate	Moderate / Low	Low	Very Low
	UNLIKELY	Moderate / Low	Low	Very Low	Very Low

Further description of the classified risks as defined by CIRIA C552 is provided below.

Very high risk

There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without remediation action OR there is evidence that severe harm to a designated receptor is already occurring. Realisation of that risk is likely to present a substantial liability to be site owner/or occupier. Investigation is required as a matter of urgency and remediation works likely to follow in the short-term.

High risk

Harm is likely to arise to a designated receptor from an identified hazard at the Site without remediation action. Realisation of the risk is likely to present a substantial liability to the Site owner / or occupier. Investigation is required as a matter of urgency to clarify the risk. Remediation works may be necessary in the short-term and are likely over the longer term.

Moderate risk

It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely, that the harm would be relatively mild. Further investigative work is normally required to clarify the risk and to determine the potential liability to Site owner / occupier. Some remediation works may be required in the longer term.

Low risk

It is possible that harm could arise to a designated receptor from identified hazard, but it is likely at worst, that this harm if realised would normally be mild. It is unlikely that the Site owner / or occupier would face substantial liabilities from such a risk. Further investigative work (which is likely to be limited) to clarify the risk may be required. Any subsequent remediation works are likely to be relatively limited.

Very low risk

It is a low possibility that harm could arise to a designated receptor, but it is likely at worst, that this harm if realised would normally be mild or minor.

Discussion of Acute Risk to Construction Workers

AECOM understands that the proposed development works will be undertaken in compliance with the Construction (Design and Management) (CDM) Regulations 2015[34].

Prior to work commencing, a health and safety risk assessment should be carried out by the appointed Principal Contractor / developed in accordance with current health and safety regulations. This assessment should cover potential risks to construction staff, permanent site staff and the local population. Based on the findings of this risk assessment, appropriate mitigation measures should be implemented during the construction period.

The greatest potential for generation of dust will be during the Site works and therefore dust generation should be kept to a minimum in accordance with general best practice, as outlined in, for example, 'Environmental Good Practice on Site', CIRIA Publication C692 to reduce this risk.

The risk to construction workers during the excavation and construction phases in terms of potential exposure to high concentrations of contaminants is considered to be low given the historic and current land uses identified at the Site. Should gross contamination be identified during the construction phase, then this may pose a potential acute risk to construction works. It is likely to be able to be effectively managed through good health and safety practices and protocols. Adoption of appropriate dust suppression techniques would also mitigate the degree of potential particulate migration off-site.

[34] UK.gov, 2015. *Construction (Design and Management) Regulations 2015*

Appendix B Photographic Log

Appendix C Groundsure Report

Appendix D Historical Borehole Logs

Appendix E Council Contamination Response

Appendix F Zetica UXO Risk Mapping / Preliminary UXO Desktop Report

Appendix G Historical Reports

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